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Title: V.A.A.R.E.D. Measurements for Air Sampler Filters

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V.A.A.R.E.D. Measurements for Air Sampler Filters

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Los Alamos National Laboratory
2019

1. Viscous Flow and Pressure
2. Alpha FWHM of ^{218}Po peak
3. Absorption, self (mass loading)
4. Radon Progeny Collection (natural aerosol)
5. Efficiency (Aerosol Collection)
6. Depth (Burial of non-natural aerosol)

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What portions should be delayed in anticipation of a new technical standard?

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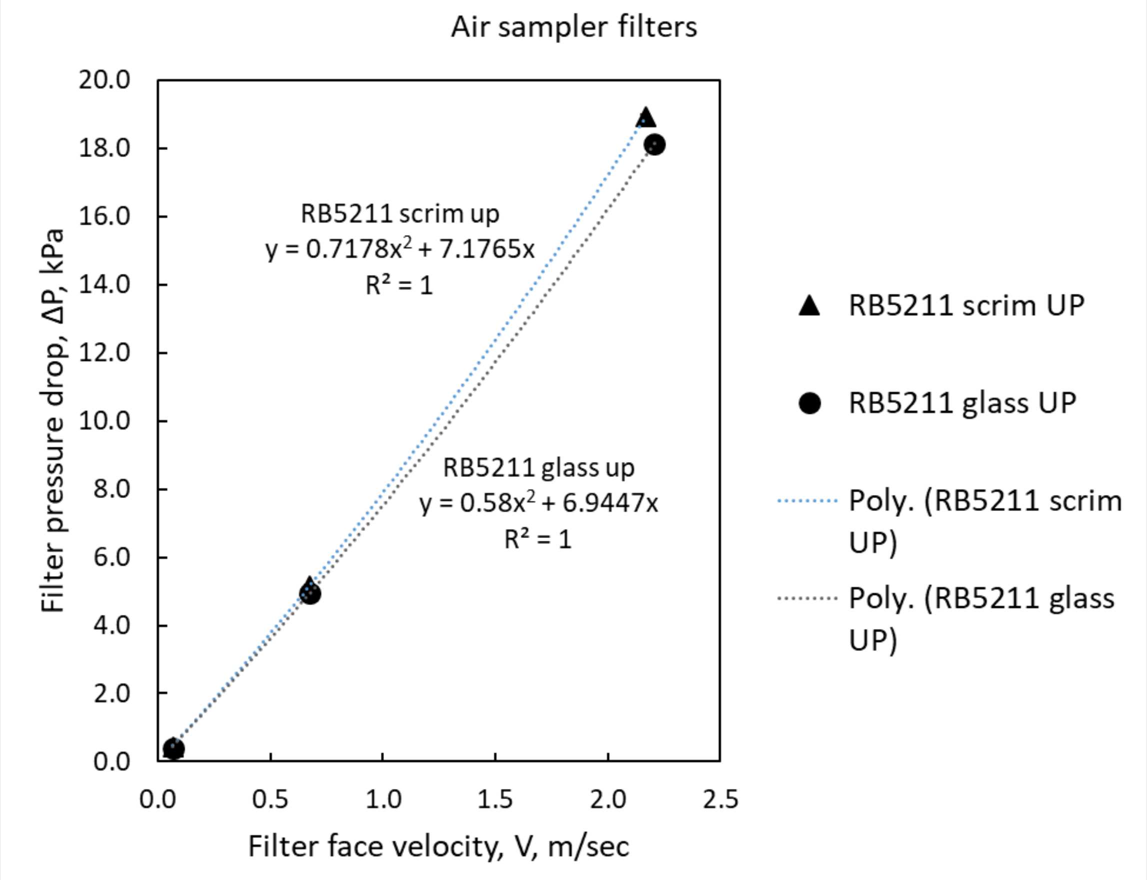
1. Viscous Flow and Pressure

Filter face velocity versus pressure drop fitted to a second order polynomial.

Moore et al. 2018. LA-UR-18-30267



5. Efficiency (aerosol collection)

Moore et al. 2018. LA-UR-18-30267

Table 1. Total report data: face velocity (flow rate) versus pressure drop, alpha spectrum resolution and filter collection efficiency at 0.3 µm particulate diameter.

Filter type	Filter face velocity test condition, m/s	Velocity, m/s	Equivalent flow rate for TA-55 FAS, ACFM	ΔP, inHg	FWHM, keV	Eff @ 0.3 µm (with OPS)
RB5211 glass fiber up	Efficiency test	0.066	0.22	0.14	n/a	100.0
	Efficiency test	0.674	2.27	1.46	n/a	100.0
	Efficiency test	2.205	7.44	5.37	n/a	99.922
	FWHM in CAM	0.75	2.54	1.64	1200	n/a
RB5211 scrim side up	Efficiency test vel.	0.066	0.22	0.14	n/a	100.0
	Efficiency test vel.	0.673	2.27	1.52	n/a	99.965
	Efficiency test vel.	2.167	7.31	5.60	n/a	99.973
	FWHM in CAM	0.73	2.44	1.65	2720	n/a

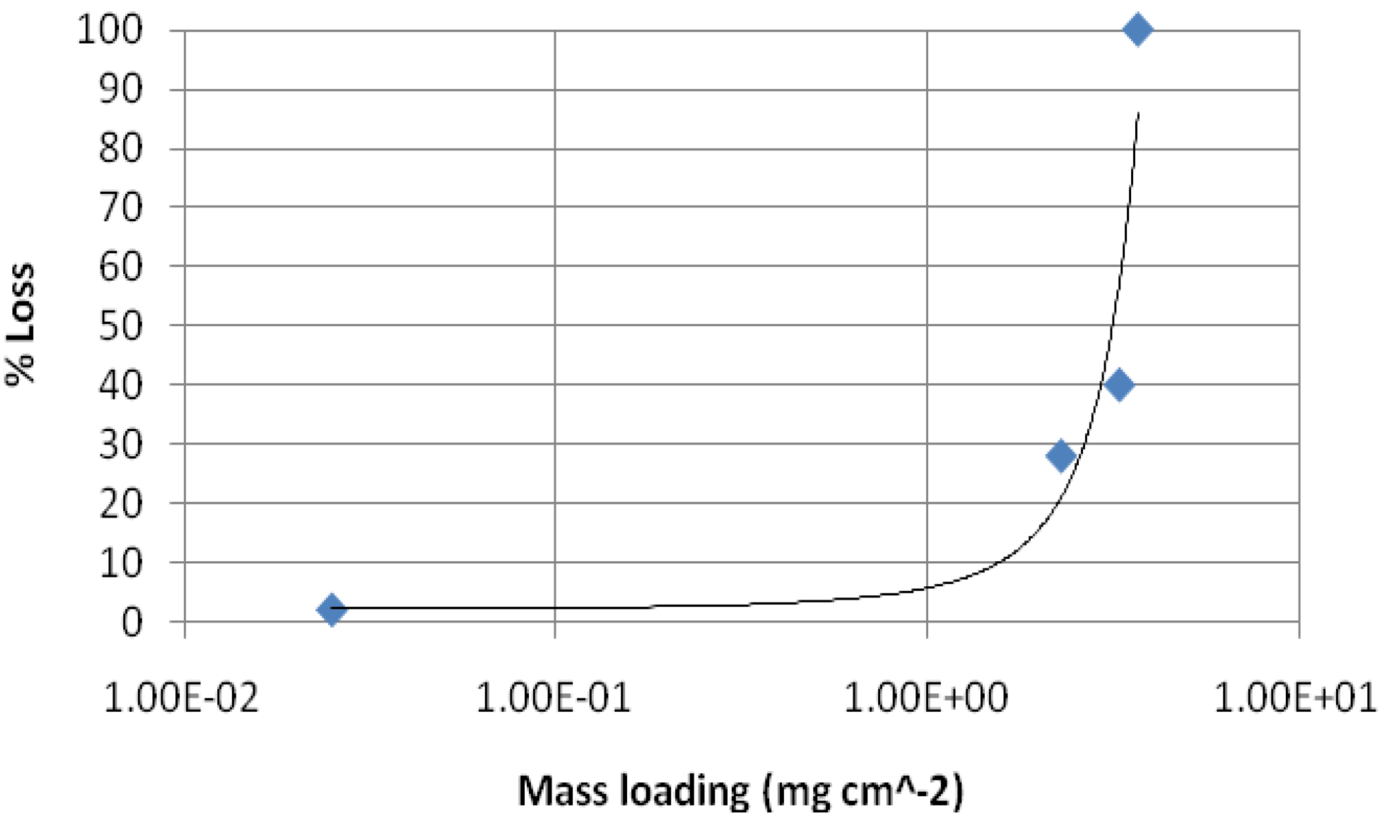
3. Absorption (self) versus mass loading

and

6. Depth of burial

3. Absorption (self) versus mass loading

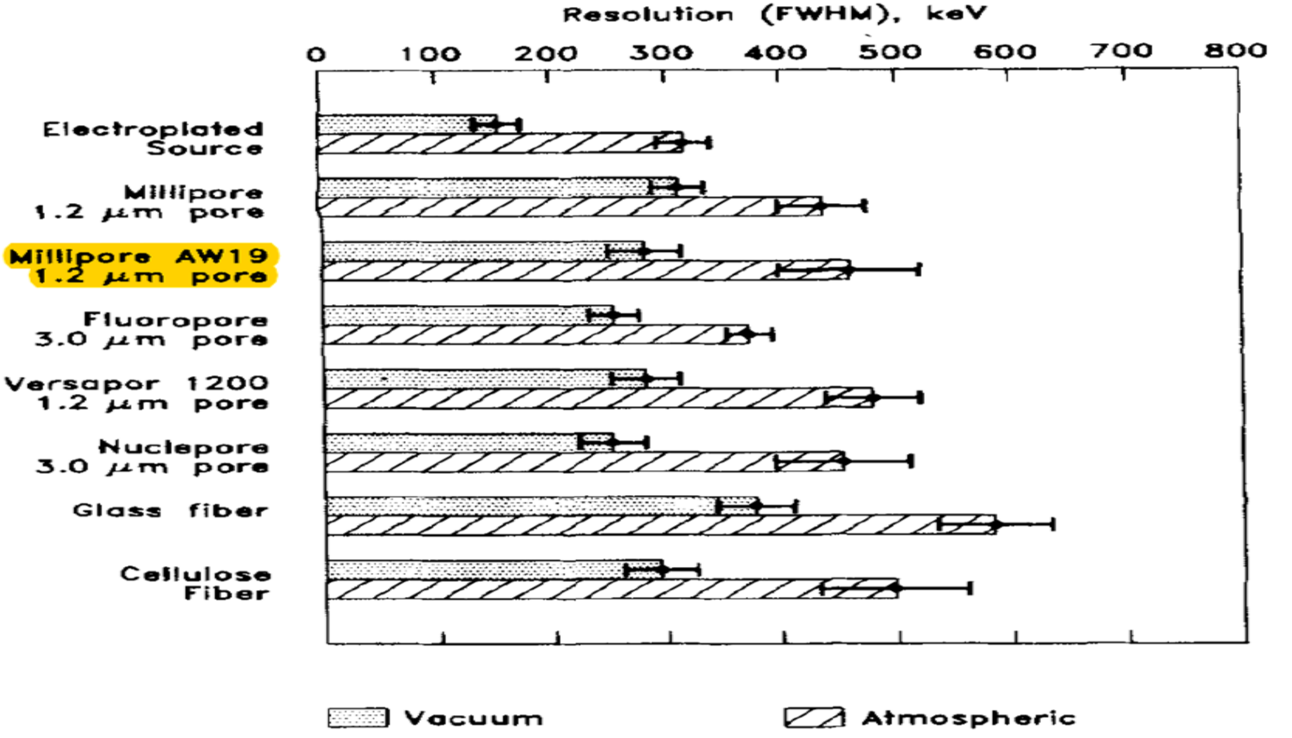
Barnett JM. 2011. Concepts for environmental radioactive air sampling and monitoring..pdf



Percent loss due to self-absorption versus mass loading[1]

6. Depth of burial

Moore McFarland Rodgers 1993 Factors That Affect Alpha Particle Detection In Continuous Air Monitor Applications



~~Fig. 2.~~ The resolution (FWHM) of the alpha spectra from 1.0-μm physical diameter uranium acetate aerosol particles collected by various filter media. Results for an electroplated source (^{239}Pu) are given for comparison. The layers of deposited aerosol particles are thin (1 μg cm^2 filter area). Source-to-detector gap = 5.0 mm. Filter active area = 925 mm^2. Detector active area = 450 mm^2.

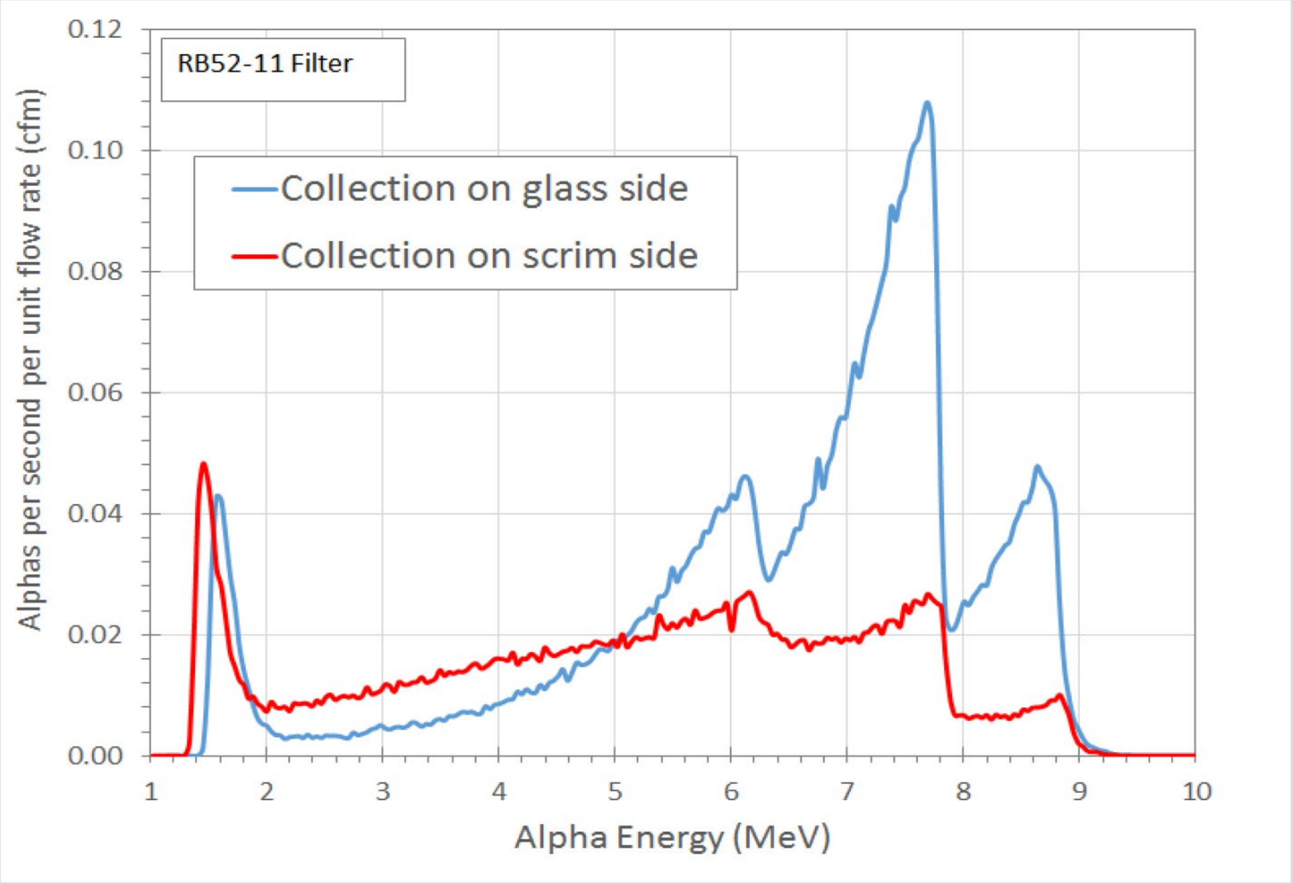
2. Alpha (^{218}Po) FWHM

and

4. Radon Progeny Collection

2. Alpha FWHM

Moore et al. 2018. LA-UR-18-30267



4. Radon Progeny Collection

Example: Note the difference between the last two columns.

Hoover and Cash (2018) based on Hoover and Newton (1991)

Filter Type	Filter Composition (and Durability)	Typical Flow Rate ($L \cdot min^{-1}$ per cm^2 per psi)[a]	FWHM of the Po-218 PEAK (keV)[b]	Relative Radon Progeny Counts in the Pu ROI[c]	Relative Radon Progeny Collection Efficiency[d]	Filter Efficiency Range (%)[e]
Versapor 3000 (3.0 µm pore size) Gelman Sciences, Ann Arbor, MI	acrylic copolymer on a nylon fibre support (rugged; both sides similar)	5.0	590	0.94	0.75 ± 0.02	99.7 to > 99.99

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VAARED measurements

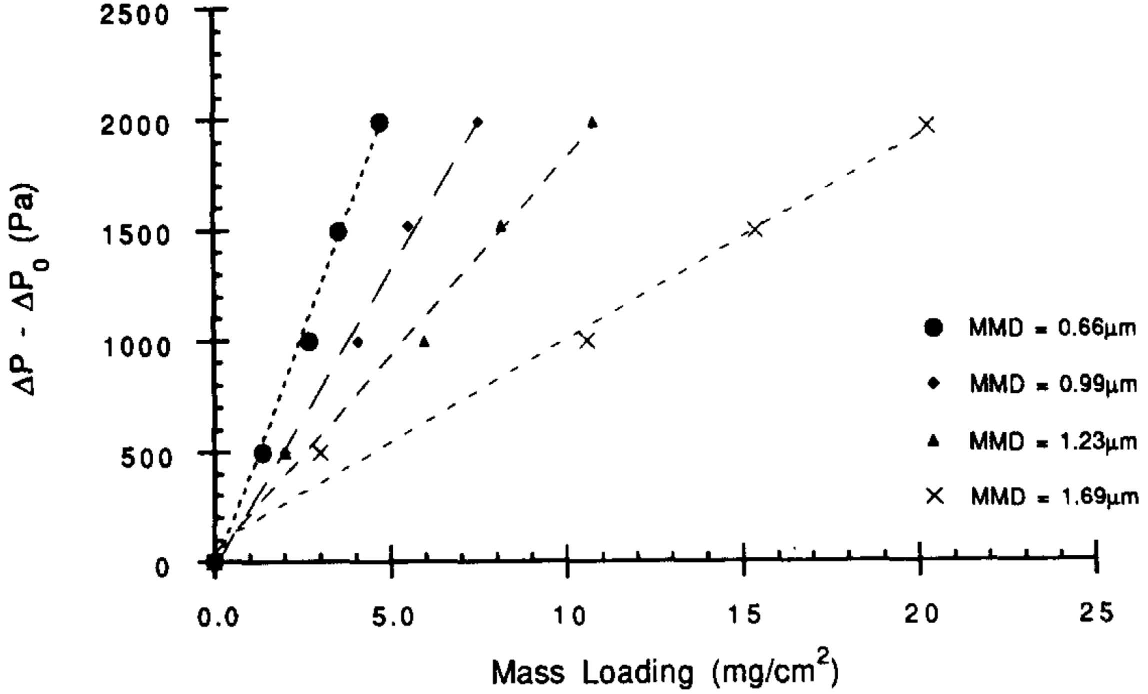
	Acronym	Aerosol type	Aerosol Size	Note	LANL 2018?
V	**Viscous Flow and Pressure**	N/A	N/A		yes
A	**Alpha FWHM**	Radon progeny	Submicron (Hoover et al 1991) versus micron (Moore et al 1993)	Dependence on aerosol type?	yes
A	**Absorption, self (mass loading)**	Transuranic material	Micron	Situation or material dependent ? A filter property or a filter condition? Difficult to do this at LANL. Optical methods?	no
R	**Radon Progeny Collection**	Radon progeny	Submicron	Natural material. This is an aspect of the burial depth measurements.	yes
E	**Efficiency (Aerosol Collection)**	ambient	Submicron and micron		yes
D	**Depth (Burial of non-natural aerosol)**	Transuranic material	Micron or submicron	Non-natural material	no

Supplemental slides

Filter Type	Filter Composition (and Durability)	Typical Flow Rate ($L \cdot min^{-1}$ per cm^2 per psi)[a]	FWHM of the Po-218 PEAK (keV)[b]	Relative Radon Progeny Counts in the Pu ROI[c]	Relative Radon Progeny Collection Efficiency[d]	Filter Efficiency Range (%)[e]
Millipore Type SMWP (5.0 µm pore size) Millipore Corp, Bedford, MA	mixed esters of cellulose acetate and cellulose nitrate (fragile; electrostatic; both sides similar)	3.2	670	1	1	98.1 to > 99.99
Millipore Type AW19 (5.0 µm pore size) Millipore Corp	homogeneous, microporous polymers of cellulose esters formed around a cellulose web (rugged; both sides similar)	3.2	470	0.57	0.99 ± 0.01	99.93 to > 99.99
Durapore SVLP (5.0 µm pore size) Millipore Corp	polyvinylidene fluoride (rugged; both sides similar)	2.8	790	1.55	0.67 ± 0.01	-
Fluoropore FSLW (3.0 µm pore size) Millipore Corp	polytetrafluoro-ethylene bonded to polypropylene high-density fibers (rugged; front is membrane; back is fibres; sides barely distinguishable by naked eye)	4.6	350	0.47	1.04 ± 0.02	98.2 to > 99.98
Fluoropore FMLB (5.0 µm pore size) Millipore Corp	Polytetrafluoroethylene bonded to polypropylene high-density fibers (rugged; front is membrane; back is fibers; sides distinguishable by naked eye - high contrast backing)	12	460	0.67	0.96 ± 0.04	
Versapor 3000 (3.0 µm pore size) Gelman Sciences, Ann Arbor, MI	acrylic copolymer on a nylon fibre support (rugged; both sides similar)	5.0	590	0.94	0.75 ± 0.02	99.7 to > 99.99
Gelman Type A/E (~1.0 µm pore size) Pall-Gelman, East Hills, NY	borosilicate glass fibre without binder (breakable during handling; both sides similar)	5.0	≥ 1000	1.31	0.92 ± 0.01	99.6 to > 99.99
Whatman EPM 2000 Whatman LabSales, Hillsboro, OR	borosilicate glass microfiber without binder (breakable during handling; both sides similar)	4.0	≥ 1000	1.48	1.00 ± 0.03	-
Whatman 41 Whatman LabSales	cotton cellulose filter paper (rugged; currently used primarily for liquid filtration; both sides similar)	5.0	≥ 1500	1.65	0.42 ± 0.01	43 to > 99.5
Nuclepore (0.6 µm pore size) VWR Scientific, Pleasanton, CA	polycarbonate membrane (rugged; thin; very electrostatic; currently used primarily for liquid filtration; collection side recommended by manufacturer is the shiny side)	0.8	500	0.89	0.85 ± 0.02	53 to > 99.5
Millipore Type AABP (0.8 µm pore size) Millipore Corp	mixed esters of cellulose (fragile; electrostatic; collection side is darker)	1.4	520	0.91	1.05 ± 0.01	99.999 to > 99.999

Note: Radon Progeny Collection

Hoover and Cash (2018) based on Hoover and Newton (1991)



Net increase in pressure drop as a function of mass loading for different particle distributions of NaCl aerosol.

Novick VJ, PR Monson and PE Ellison. 1992. The effect of solid particle mass loading on the pressure drop of HEPA filters. J Aerosol Sci. 23.6: 657-665.

END